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COLLECTING, EXTRACTING, AND MARKETING SOUTHERN PINE SEED

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During the 20 years from 1916 through 1935, the commerce in seed of longleaf, slash, loblolly, and shortleaf pines has grown by extremely irregular stages from practically nothing to many tons of seed each year. The importance of the South for timber production, and the launching of new forestry work in connection with the Emergency Conservation Work in 1933, make it likely that in general the demand for seed will continue or increase, but the uncertainty of markets in any one year, the variations in the seed crops themselves, and the technical processes involved in extraction require that seed collectors be well informed if they are to gather seed profitably or efficiently. Certain general information of use to collectors is summarized in this paper.

Much of the seed collecting so far carried on in the South has been done by men without special training in the work, or men collecting for one season only, and with no idea of creating a permanent business. As is usual under such circumstances, some of the seed has been poorly cleaned and of low quality, and much of it has been collected from any trees available, without thought of their possibly bad hereditary qualities. The situation offers a definite opportunity for skillful, reliable collectors and extractors who will concentrate their efforts upon cones from trees of high quality, develop sound and efficient methods of extraction, and certify the species, parentage, age, treatment, cleanness, and soundness of the seed they sell.

The southern pine seed business includes three technical steps--scouting, collecting, and extracting. It is well to scout cones before booking orders for seed, and to book orders for most of the seed to be collected before investing anything but spare time in the work. The collector who neglects these precautions faces the risk, on one hand, of accepting orders he cannot fill, and on the other, except possibly in years of scanty crops or of suddenly expanded state or federal planting, of tying up an investment in unmerchantable seed.

Cones can be collected most easily from felled trees. The disadvantages of this method, however, are that logging or other cutting is not always going on in bearing stands at the time cones are mature, and that cones from later crops cannot be collected from the same trees, no matter how desirable seed from those trees has proved to be. Collection from standing trees varies greatly in difficulty. Heavy crops of cones on longleaf and slash pine trees less than 40 or 50 feet high, with

short branches and with the lowest living branches fairly near the ground, are relatively cheap to gather. Loblolly and shortleaf cones on similar trees, and cones of any species on tall trees with long, clear trunks and wide crowns, are far more expensive to knock down or pick. If seed is to be collected only from trees of the best form, it is easier to select such trees in uncut stands than on a logging operation. These points should be kept in mind while scouting for cones and estimating costs of collection. Before entering into contracts for large quantities of cones, it is well to time the picking of a few bushels and find out how long it takes and how much it costs per bushel.

SCOUTING FOR CONES

Estimates of the quantities of cones available for collection should be based on counts of cones and of trees bearing cones, taken in the course of more or less systematic scouting trips over the territory in which the collector expects to work. The large cones of longleaf and slash pines are easy to see and can be counted fairly accurately. Loblolly and shortleaf cones are much harder to see, especially on tall trees, and an accurate count is practically impossible, but, for his own protection, the collector should make sure that he can get *at least* the quantity ordered before he undertakes collection. No great harm is done if he somewhat underestimates the actual supply.

The number of cones available in an entire tract can be estimated by counting or estimating the cones on a number of quarter-acre or acre plots scattered uniformly over the area, reducing the figures to average number of bushels per acre and multiplying the number of bushels per acre by the number of acres in the tract. The more uniform the figures for the separate plots, and the greater the number of plots, the more reliable the final estimate will be. Fair estimates of the cones available on small tracts, or on the total number of trees to be cut on a given logging operation during the collecting season, may often be obtained by multiplying the total number of trees by the average yield per tree as determined by counting cones on 20, 50, or 100 trees chosen at random to give a fair sample of the stand.

TABLE 1. -- *Numbers of cones per bushel*

Species	Usual number	Extreme values observed[1]	
		Lowest	Highest
Longleaf	100	86	118
Slash	200	157	243
Loblolly	500	393	1,080
Shortleaf	2,000	1,444	2,545

[1] Cones from vigorous young trees tend to be above average size, and hence below the average number per bushel. The reverse is true for cones from very old trees.

Figure 1 shows the general appearance and relative size of the cones of the four species under discussion. Table 1 gives figures useful in converting numbers of cones to bushels.

FIGURE 1. -- Cones of longleaf, slash, loblolly, and shortleaf pines photoghaphed against a background of 1-inch squares

Scouting for cones can be done as early as May or June, because cones are full size by then, and fairly easy to see. It is better, however, to scout in early August, because there is then less time between scouting and collection for drought, storms, and insects to injure the cones. In August, too, by cutting open a few cones from each of several trees, the collector can tell whether a fair percentage of the seeds contain kernels. It sometimes happens that in limited or even in extensive areas the cones contain few good seeds, while on other equally accessible areas nearby the seeds are of high quality; in such instances it is plainly to the interest of the collector to supply the better seed.

It is believed that the seeds of southern pines mature before the cones do; that is, that seed fit for use in nurseries can be extracted as early in the season as the cones can be made to open by drying. Collectors have experienced difficulty many times in the past both from gathering cones a trifle early without treating them as carefully as necessary under such conditions, and from gathering them very early and having them fail to open under any treatment. Unless the quantity of cones needed is so great that a long collecting season is essential, the safest plan is to wait until all cones have begun to turn brown, or even until the first few cones (usually those on the south sides of crowns) have begun to open. Table 2 gives, for States from Georgia and Florida to Texas, the usual dates of maturing and collection of cones and shedding of seed. Some departure from the dates given in this table may, however, be expected because of local and seasonal variations; therefore the collector should keep a sharp watch of the cones themselves.

TABLE 2. -- *Usual dates of maturity, collection, and natural opening of cones of southern pines in the states from Georgia and Florida to Texas*

Species	Maturity	Collection	Opening on trees
Longleaf	October 1 to 20	October 1 to 20	October 20 to November 10
Slash	September 1 to 10	September 1 to 20	September 20 to 30
Loblolly	September 20 to October 10	October 1 to 20	October 10 to 30
Shortleaf	October 1 to 20	October 11 to 30	November 1 on

One of the chief points to be observed in table 2 is the exceptionally early maturity of slash pine cones.

An individual or firm collecting cones on land belonging to another should obtain permission, preferably in writing, before beginning to collect.

MARKETING AGREEMENTS

First attempts at purchase or marketing of seed have sometimes led to misunderstandings, disagreements, and financial hardships. Observance of the following rules should help to eliminate such difficulties:

1. Place orders, for either cones or seed, before the earliest date of collection for the species.

2. Specify, in writing, the *maximum* quantity of cones or seed that will be accepted that season at the price agreed upon. Many a man has advertised in the papers or elsewhere for cones at so much a bushel or seed at so much a pound, without specifying any top limit to the quantity he would take, and as a result has had to purchase far more than he wanted or else incur ill feeling. Rule 2 does away with this danger. It is sometimes well, however, to include in the sales agreement an option on an additional quantity at a specified price, to be taken up or abandoned by a specified date.

3. Specify in writing the unit of measure, the price per unit, standards of quality of cones (for example, not more than 10 percent wormy cones), point of delivery, degree of shelter to be given cones until shipped or called for, and frequency of shipment or call.

In connection with rule 3, purchase by volume is preferable to purchase by weight, because of the extremely rapid loss of weight by cones during the very period at which most of them are shipped and sold. Longleaf cones collected late in September may weigh 45 pounds per bushel, those collected late in October as little as 25 pounds, and cones may lose 20 percent of their weight through unavoidable delay in delivery. It is obviously inequitable to base payment on such a changeable unit as weight, while actually the volume and the number of seeds obtainable from that volume remain the same.

COLLECTING AND SHIPPING CONES

Longleaf and slash cones are detached from the trees so easily that on logging operations the cones usually fall off when the trees hit the ground. Loblolly and shortleaf cones have to be picked from crowns of felled trees by hand; leather-palmed gloves are almost essential in picking loblolly cones because of the sharp prickles. With all four species of southern pine, collection is easiest before skidding of the logs has disarranged the tops, covered some of the cones, and made it difficult to judge the quality of individual trees.

Collection by climbing, as has been noted, is likely to be considerably more expensive than collection from felled trees, especially in the case of loblolly and shortleaf pines. It reaches its lowest cost in the case of small young trees with easily accessible crowns. There seems to be little basis for the belief, sometimes encountered, that seed from young trees is poor in quality.. Seed from young trees does sometimes include an abnormally high percentage without kernels, with an abnormally low yield of sound seed per bushel of cones as a result. This is thought to be the result of the wide spacing and consequently poor pollination of the seed bearers in young stands, rather than the actual immaturity of the trees. Such low percentages of sound seed should be revealed by scouting prior to collection. Sound seed (that is, seed with kernals) from young trees usually shows excellent germination and growth.

Light ladders are generally satisfactory for reaching the crowns of trees less than 50 feet high, but some collectors prefer climbing irons even for such trees; for larger trees, and especially for very tall ones with long, clear trunks, irons and safety belts are a necessity.

Once in the crown, the collector needs something to loosen the cones not actually within arm's reach. A bamboo pole 8 to 12 feet long, with a suitable prong or hook on one end and a thong at the other end to slip around the wrist, works well. Longleaf and slash cones are easily removed, and for these species a Y-shaped head of $\frac{1}{4}$-inch strap iron, $1\frac{3}{4}$ inches between the points, is satisfactory. For loblolly and shortleaf some sort of sharp hook should be combined with the prong.

In actual collection from either felled or standing trees, the most rapid process it is to gather the cones in bushel baskets and then pour them into sacks. Gathering directly in sacks is slow and inefficient. As the cones are tossed into the baskets, they should be freed of all trash such as pine needles, bark, and grass. If this method is used, no rehandling of single cones is necessary for either cleaning or measuring.

Except in years of great scarcity of seed, wormy cones should not be collected. They usually yield but one third to one half as much seed as sound cones, and break up badly in the tumbler and fill the seed with bits of cone scale very difficult to remove.

Cones are best shipped in sacks. Cones shipped loose are expensive to handle, and in large quantities, such as 1,000 bushels shipped in a boxcar, the lower layers become crushed and spoiled. Two-bushel sacks are generally preferred, although one-bushel sacks are easier to unload into the smaller types of extracting trays. The use of sacks of mixed sizes should be avoided if cones are being sold by volume, because they cause confusion in tallying. Sacks of loose weave are preferable to those of tight weave, which slow down the natural drying of the cones and sometimes in-

crease the danger of mold. Fertilizer sacks should not be used. Sacks should never be sewed or fastened with wire, because pieces of wire may become mixed with the cones and ruin seed-cleaning machinery.

Cones should be shipped promptly after collection, and should at all times be given as much ventilation as possible. They should be protected from rain. The shorter the time they are left in sacks, the higher the yield of seed will be, and the better the quality of the seed.

EXTRACTING SEED

The seed can be extracted from cones of southern pines either at ordinary air temperature or by artificial heat. In both cases the principal is the same: The fairly rapid removal of water equivalent to 35 to 65 percent of the original weight of the cones, in such a manner as to cause no injury to the seed. Extraction at air temperature requires less skill and less elaborate equipment, but takes longer, requires more space, usually yields less seed, and with an occasional lot of cones may fail entirely. The difficulty with using the natural heat of direct sunshine lies in exposing the cones to full sunlight without expensive equipment or excessive handling to protect them from the heavy dews and frequent rains of the Southern States.

Extraction by artificial heat saves time and space in large operations, and ordinarily gives higher yields and possibly seed in better condition for sowing or storage. Some lots of longleaf and shortleaf pine cones, and possibly all lots of any species gathered early in the season, require a short period of "precuring" or partial drying at air temperature, to prevent their casehardening in the kiln and remaining permanently closed.

Experience has shown that no matter what the method of extraction, best results are obtained by spreading the unopened cones only one layer deep on floors, shelves, trays, or other equipment used for drying. In precuring before kiln extraction they may be spread 3 or 4 layers deep.

A bushel of unopened cones may weigh as much as 45 pounds. As a result of drying, the scales of the cones open until the bushel of cones occupies $2\frac{1}{2}$ to $3\frac{1}{2}$ times as much space as it did originally. Cones lying only one layer deep vary in their requirements for floor space or rack space per bushel, depending on the average diameter of the cones. This size in turn varies with species. Racks placed one above another must clear by a distance about equal to the length of the cones, which again varies with species. Sizes and desirable clearances of racks are given in table 3. Each unit of extracting equipment must be designed with allowance for the maximum weight of unopened cones to be loaded upon it, and for the maximum volume of the same cones after opening. In large plants the weight to be placed upon upper floors should be figured carefully, and the floor made amply strong to carry this weight. In figuring the capacity of a tumbler, it must be remembered that the tumbler must take care of about three times the volume represented by the unopened cones originally delivered at the plant.

A side-hill makes an excellent location for an extracting plant, as the cones can be delivered by truck to the upper floor or to curing sheds on or just above the same level, and, after opening, can be dumped or shoveled through a chute into the tumbler on the floor below. Details such as these increase in importance with the size of, and the investment in, the plant.

TABLE 3. -- *Effective capacities of cone trays of various sizes, and desirable clearances between trays*

Species	Capacities of trays measuring			Desirable vertical clearances between trays
	2 by 4 feet	3 by 3 feet	3 by 4 feet	
	Bushels			*Inches*
Longleaf	1.0	1.1	1.5	10
Slash	0.8	0.8	1.1	8
Loblolly	0.5	0.6	0.8	6
Shortleaf	0.4	0.4	0.6	4

Cones can be opened at air temperature on any fairly smooth, tight floor, on a rough floor covered with tarpaulins or building paper, on series of shelves, or, best of all, on tiers of wire-bottomed trays. Trays 3 by 4 feet, 2½ by 6 feet, and 4 by 5 feet have all proved convenient; the exact dimensions depend in part on the size and design of the room available. The sides of the trays may be of 1 by 3-inch pine or cypress, reinforced with angle irons at all four corners. The bottoms may be of ½-inch mesh hardware cloth, if seed is to be permitted to sift down from tray to tray, or of screen wire 16 meshes to the inch if, as is often desirable, the seed is to be kept separate by trays. Heavier trays should be built if rough handling is anticipated.

A loft under a hot roof makes an excellent place for air extraction. One of the best air-temperature plants on record was an abandoned work car on a siding, with cone trays where the bunks had been. The effectiveness of the plant depends on good cross-ventilation of cones in single layers, on efficient use of space, and on means of handling the cones a trayful at a time, or with scoops or chutes. The cones and seed must of course be protected from moisture and from mice.

Effective extraction by artificial heat requires that relatively dry air, at a temperature considerably above that of the air outside but still not hot enough to injure the seed, be circulated freely and rapidly among the cones. The highest safe temperature depends upon a number of things, including the species of cone, and has not been determined exactly, but experiments and experience have shown clearly that no harm results with a maximum of 120° F., provided good circulation is maintained, and provided the moisture content of the cones is not too high at the time they are put in the kiln.

The simplest and least expensive type of kiln for the use of artificial heat in extracting pine seed is of the so-called convection type. This depends for its action on the tendency of hot air to rise. It consists of a cell, or a series of cells, each perhaps 3 by 4 feet by 8 feet high, containing trays of cones one above another, with a source of heat below each cell and a generous outlet or series of outlets at the top. Such cells are most conveniently located in a building set well above the ground on posts, or in the upper part of a 2-story building. One such kiln has been constructed inside a sweetpotato house; a much larger one has been installed in the second floor of an abandoned fire-engine house in a small town. The higher the cell, itself, or the higher the combination of cell and the ventilator pipe or flue in its roof, the better will be the upward circulation of air, just as the draft is better

TESTING AND STORING SEED

A discussion of laboratory tests of the actual germination of fresh and stored seed is beyond the scope of this paper. The extractor and dealer should, however, have a clear idea of the quality of his seed at different stages in the cleaning process, and especially at the time of sale. Fresh seed can be tested for soundness by smashing samples with a hammer, one seed at a time, and recording the percentages sound and empty. If there is doubt about the soundness of seed containing kernels, a more accurate determination can be made by cutting the seeds with a sharp knife and separating the sweet, sound seeds from the softened and discolored ones. Separate samples should be drawn at random from different parts of the lot to be tested; 5 samples of 100 seeds each, if their quality checks within a few percent, give a tolerably accurate measure of the entire lot. Such "hammer tests" and "cutting tests," however, invariably show a higher percentage of sound seeds than do actual germination tests, and should be used with caution in advertising.

In general, seed keeps best in airtight or nearly airtight containers, at low moisture content, and at low temperatures. For storage from the time of extraction in the fall to the time of sowing the following spring, ash cans or garbage cans with tight covers have proved very satisfactory, if kept in unheated buildings. Kiln-extracted seed has shown a tendency to keep somewhat better than seed extracted at air temperature, possibly because of its lower moisture content. Before putting it in cans, it is advisable to expose air-extracted seed to the sun for 6 or 8 hours in shallow layers stirred at frequent intervals, to insure its being thoroughly dry.

Seed to be kept a year or more should be dried thoroughly, stored in airtight or friction-top containers, and kept at a temperature of 35° to 38° F.

All lots of seed shipped or stored should be marked distinctly. The label should show species, date and place of collection, collector, method of extraction, and preferably character of parent trees and data concerning cleaning and degree of soundness.